

What is claimed is:

1. An energy curable composition comprising:  
a compound having  
an aromatic or heteroaromatic moiety;  
at least two fluorinated alkylene, arylene or polyether moieties, each fluorinated alkylene, arylene or polyether moiety being linked to the aromatic or heteroaromatic moiety through an ether or thioether;  
at least one ethylenically unsaturated moiety, each ethylenically unsaturated moiety being linked to one of the fluorinated alkylene, arylene or polyether moieties.

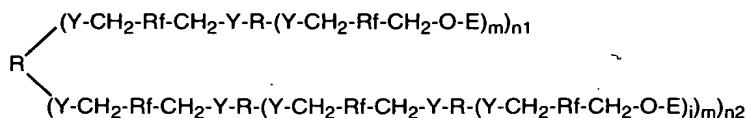
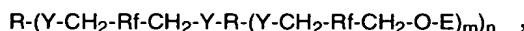
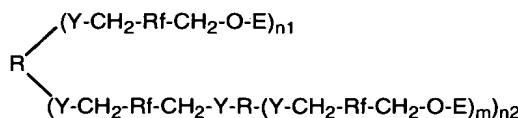
2. The energy curable composition of claim 1 wherein the compound has the formula

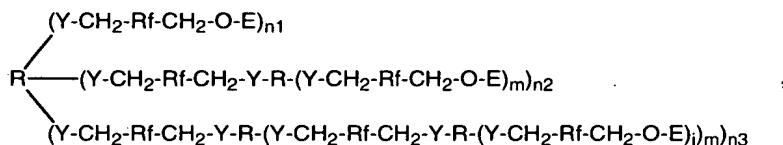
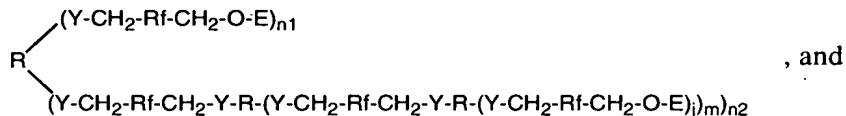
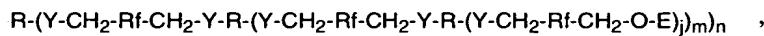


wherein

R is the aromatic or heteroaromatic moiety;  
Y is O or S;  
Rf includes the fluorinated alkylene, arylene or polyether moiety;  
E is the ethylenically unsaturated moiety; and  
n is 2, 3 or 4.

3. The energy curable composition of claim 1 wherein the compound has a formula selected from the group consisting of

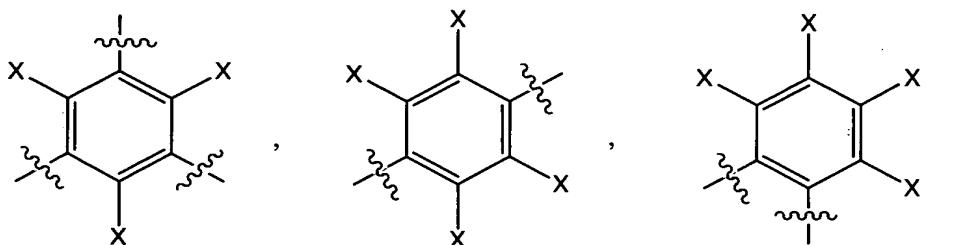


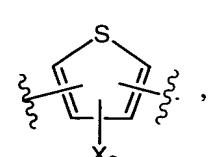
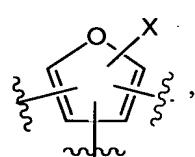
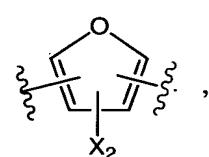
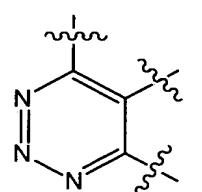
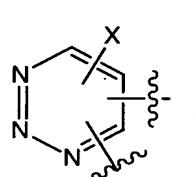
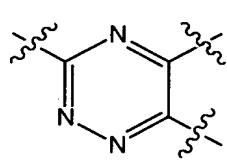
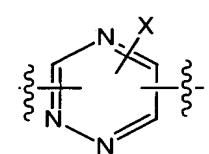
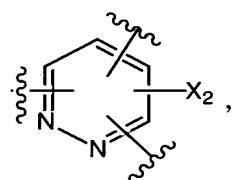
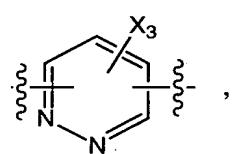
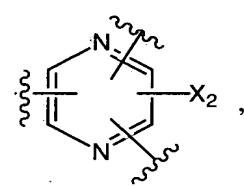
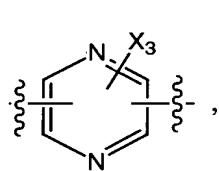
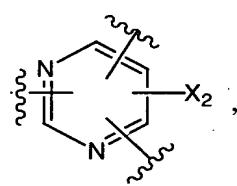
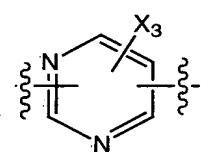
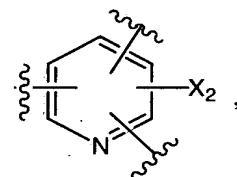
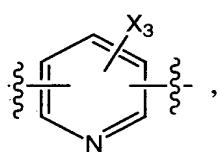
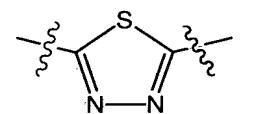
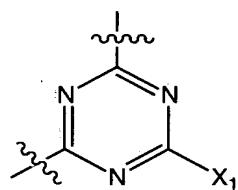
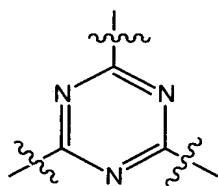
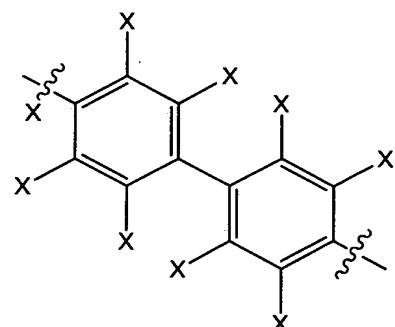
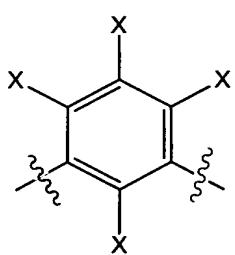


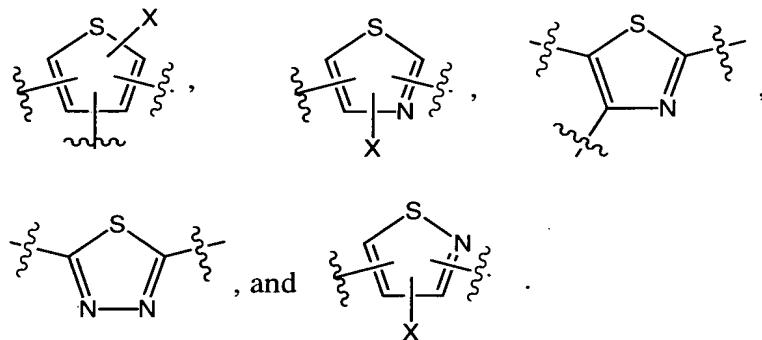
wherein

- each R is an aromatic or heteroaromatic moiety;
- each Y is O or S; each Rf includes a fluorinated alkylene moiety, a fluorinated arylene moiety, or a fluorinated polyether moiety;
- each E is an ethylenically unsaturated moiety;
- each j is 1, 2, or 3;
- each m is 1, 2 or 3;
- each n subscript is 0, 1, 2, 3 or 4; and
- the sum of the n subscripts in each formula is 2, 3 or 4.

4. The energy curable composition of claim 1 wherein the aromatic or heteroaromatic moiety is selected from the group consisting of







5. The energy curable composition of claim 1 wherein the fluorinated alkylene, arylene or polyether moiety is selected from the group consisting of

- $(CF_2)_x-$ ,
- $(C_6F_4)_x-$
- $CF_2O-[ (CF_2CF_2O)_m (CF_2O)_n ]-CF_2-$ ,
- $CF(CF_3)O(CF_2)_4O[ CF(CF_3)CF_2O ]_p CF(CF_3)-$ , and
- $CF_2O-(CF_2CF_2O)_m-CF_2-$ ,

wherein x is an integer between 1 and about 10;

m and n designate the number of randomly distributed perfluoroethyleneoxy and perfluoromethyleneoxy backbone repeating subunits, respectively; and p designates the number of - $CF(CF_3)CF_2O-$  backbone repeating subunits.

6. The energy curable composition of claim 1 wherein each ethylenically unsaturated moiety is selected from the group consisting of acrylate, methacrylate, haloacrylate, halomethacrylate, vinyl ether and allyl ether.

7. The energy curable composition of claim 1 having a  $C_H$  of less than about 55 M.

8. The energy curable composition of claim 1 having a  $C_H$  of less than about 20 M.

9. The energy curable composition of claim 1 having a  $C_H$  of less than about 10 M.

10. The energy curable composition of claim 1 having an absorption loss of less than about 0.5 dB/cm at 1550 nm.

11. The energy curable composition of claim 1 having an absorption loss of less than about 0.2 dB/cm at 1550 nm.

12. The energy curable composition of claim 1 having an absorption loss of less than about 0.1 dB/cm at 1550 nm.

13. The energy curable composition of claim 1 further including an initiator.

14. The energy curable composition of claim 1 wherein the compound is present in an amount of at least about 10% by weight.

15. An energy curable composition comprising:

a compound having

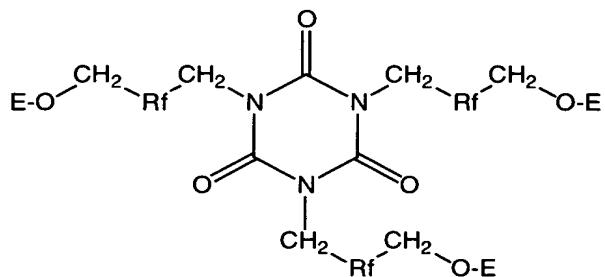
an isocyanurate moiety,

three fluorinated alkylene, arylene, or polyether moieties linked to the isocyanurate moiety at the nitrogens of the isocyanurate, and

at least one ethylenically unsaturated moiety linked to one of the fluorinated alkylene, arylene, or polyether moieties.

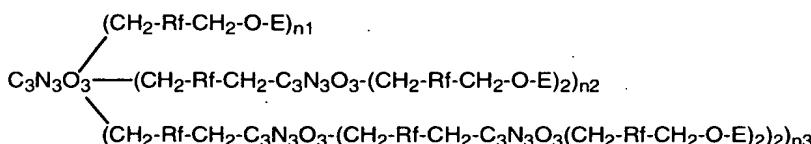
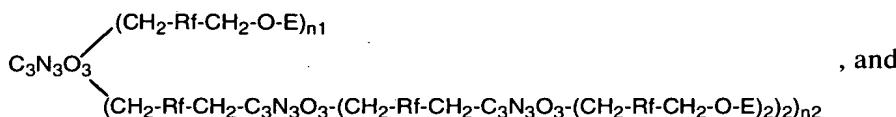
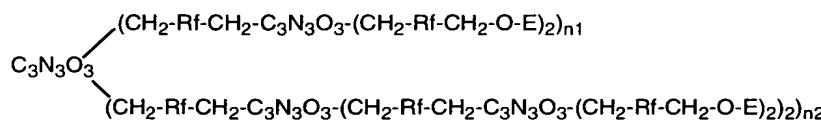
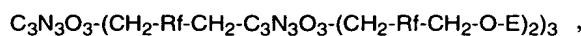
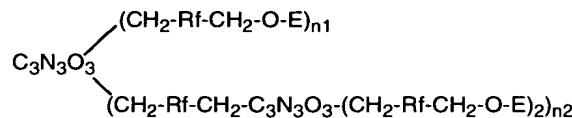
16. The energy curable composition of claim 15 comprising

a compound having the formula



wherein Rf includes a fluorinated alkylene, arylene or polyether moiety and E is an ethylenically unsaturated moiety.

17. The energy curable composition of claim 15 wherein the compound has a formula selected from the group consisting of



wherein  $\text{C}_3\text{N}_3\text{O}_3$  is the isocyanurate nucleus; each Rf includes a fluorinated alkylene moiety, a fluorinated arylene moiety, or a fluorinated polyether moiety; each E is an ethylenically unsaturated moiety; each n subscript is 0, 1, 2 or 3; and the sum of the n subscripts in each formula is 3.

18. The energy curable composition of claim 15 wherein the fluorinated alkylene, arylene or polyether moiety is selected from the group consisting of

- $-(\text{CF}_2)_x-$ ,
- $-(\text{C}_6\text{F}_4)_x-$
- $-\text{CF}_2\text{O-}[(\text{CF}_2\text{CF}_2\text{O})_m(\text{CF}_2\text{O})_n]\text{-CF}_2-$ ,
- $-\text{CF}(\text{CF}_3)\text{O}(\text{CF}_2)_4\text{O}[\text{CF}(\text{CF}_3)\text{CF}_2\text{O}]_p\text{CF}(\text{CF}_3)-$ , and

-CF<sub>2</sub>O-(CF<sub>2</sub>CF<sub>2</sub>O)<sub>m</sub>-CF<sub>2</sub>-,

wherein x is an integer between 1 and about 10;

m and n designate the number of randomly distributed perfluoroethyleneoxy and

perfluoromethyleneoxy backbone repeating subunits, respectively; and

p designates the number of -CF(CF<sub>3</sub>)CF<sub>2</sub>O- backbone repeating subunits.

19. The energy curable composition of claim 15 wherein each ethylenically unsaturated moiety is selected from the group consisting of acrylate, methacrylate, haloacrylate, halomethacrylate, vinyl ether and allyl ether.

20. The energy curable composition of claim 15 having a C<sub>H</sub> of less than about 55 M.

21. The energy curable composition of claim 15 having a C<sub>H</sub> of less than about 20 M.

22. The energy curable composition of claim 15 having a C<sub>H</sub> of less than about 10 M.

23. The energy curable composition of claim 15 wherein the compound is present in an amount of at least 10% by weight.

24. A polymeric material, the polymeric material comprising a polymer or copolymer of an energy curable composition, the energy curable composition having an aromatic or heteroaromatic moiety;  
at least two fluorinated alkylene, arylene or polyether moieties, each fluorinated alkylene, arylene or polyether moiety being linked to the aromatic or heteroaromatic moiety through an ether or thioether;  
at least one ethylenically unsaturated moiety, each ethylenically unsaturated moiety being linked to one of the fluorinated alkylene, arylene or polyether moieties.

25. The polymeric material of claim 24 wherein

the energy curable compound has the formula



wherein

R is the aromatic or heteroaromatic moiety;

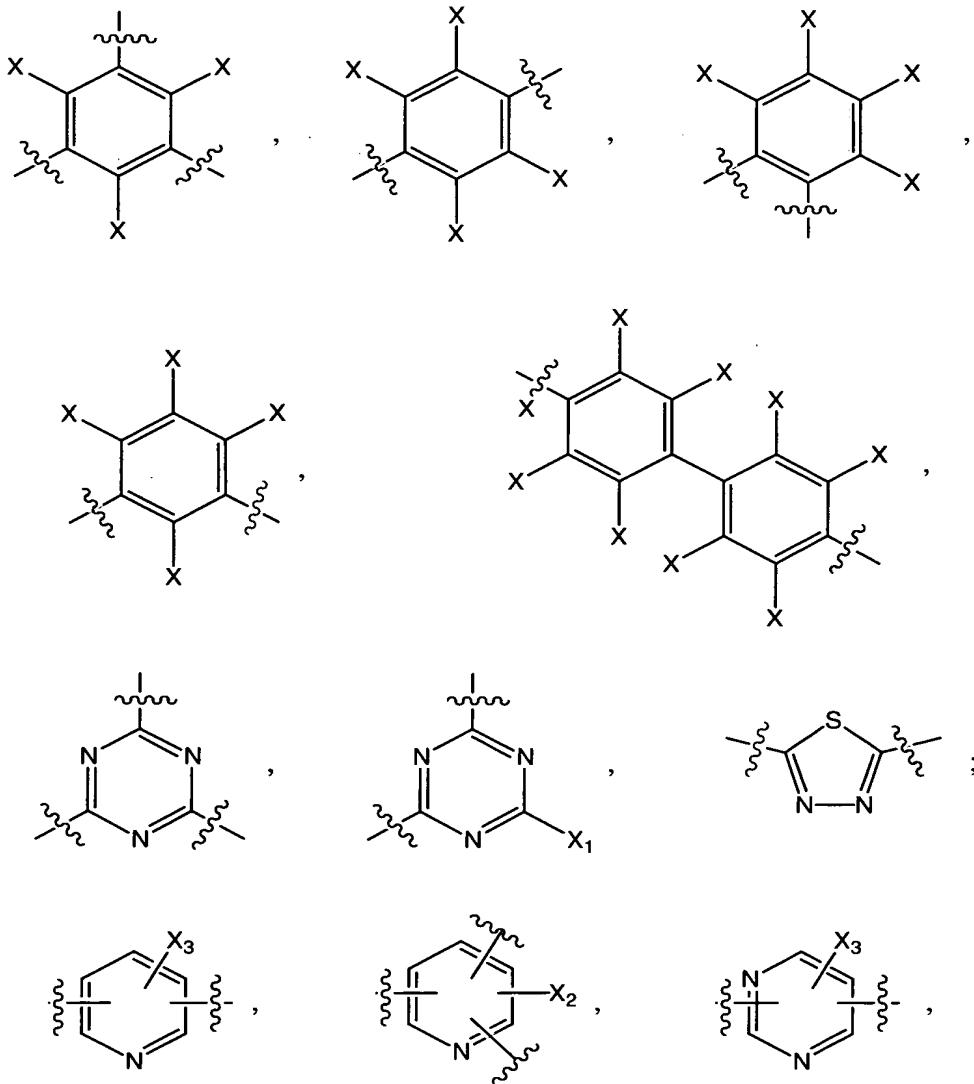
Y is O or S;

Rf includes the fluorinated alkylene, arylene or polyether moiety;

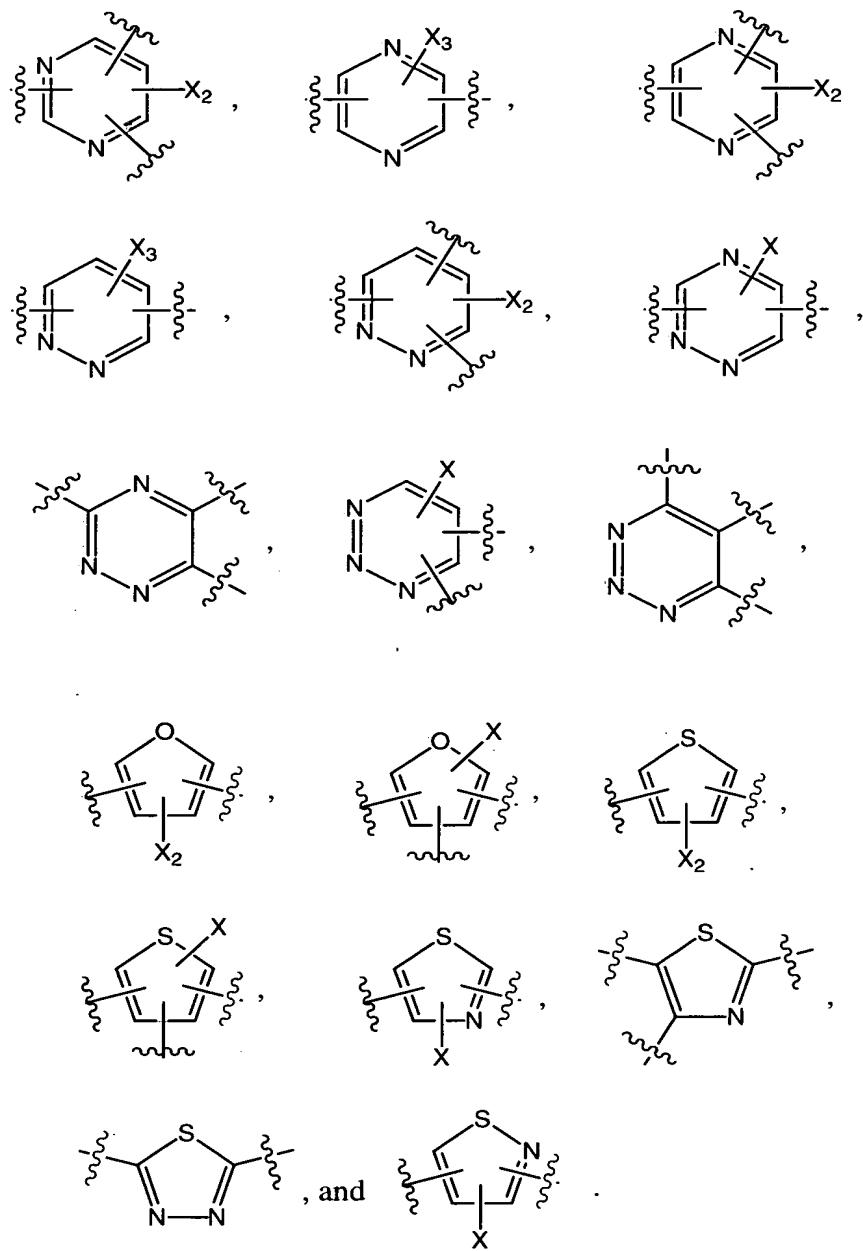
E is the ethylenically unsaturated moiety; and

n is 2, 3 or 4.

26. The polymeric material of claim 24 wherein the aromatic or heteroaromatic moiety is selected from the group consisting of



CONTINUATION



27. The polymeric material of claim 24 wherein the fluorinated alkylene, arylene or polyether moiety is selected from the group consisting of

- $(CF_2)_x$ -,
- $(C_6F_4)_x$ -
- $CF_2O - [(CF_2CF_2O)_m(CF_2O)_n] - CF_2$ -,
- $CF(CF_3)O(CF_2)_4O[CF(CF_3)CF_2O]_pCF(CF_3)$ -, and

$-\text{CF}_2\text{O}-(\text{CF}_2\text{CF}_2\text{O})_m-\text{CF}_2-$ ,

wherein x is an integer between 1 and about 10;

m and n designate the number of randomly distributed perfluoroethyleneoxy and

perfluoromethyleneoxy backbone repeating subunits, respectively; and

p designates the number of  $-\text{CF}(\text{CF}_3)\text{CF}_2\text{O}-$  backbone repeating subunits.

28. The polymeric material of claim 24 having a  $\text{C}_\text{H}$  of less than about 55 M

29. The polymeric material of claim 24 having a  $\text{C}_\text{H}$  of less than about 20 M.

30. The polymeric material of claim 24 having a  $\text{C}_\text{H}$  of less than about 10 M.

31. The polymeric material of claim 24 having an absorption loss of less than about 0.5 dB/cm at 1550 nm.

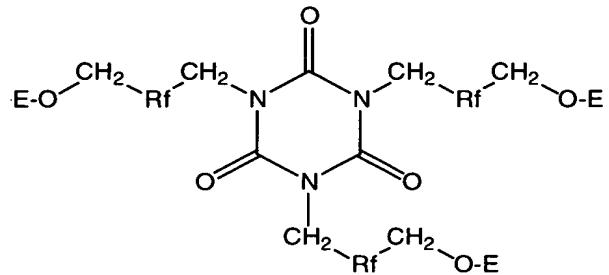
32. A polymeric material, the polymeric material comprising a polymer or copolymer of an energy curable composition including  
a compound having

an isocyanurate moiety,

three fluorinated alkylene, arylene, or polyether moieties linked to the isocyanurate moiety at the nitrogens of the isocyanurate, and

at least one ethylenically unsaturated moiety linked to one of the fluorinated alkylene, arylene, or polyether moieties.

33. The polymeric material of claim 32 wherein  
the energy curable compound has the formula



wherein Rf includes a fluorinated alkylene, arylene or polyether moiety and E is an ethylenically unsaturated moiety.

34. The polymeric material of claim 32 wherein the fluorinated alkylene, arylene or polyether moiety is selected from the group consisting of

- $(CF_2)_x-$ ,
- $(C_6F_4)_x-$
- $CF_2O-[ (CF_2CF_2O)_m(CF_2O)_n ]-CF_2-$ ,
- $CF(CF_3)O(CF_2)_4O[ CF(CF_3)CF_2O ]_pCF(CF_3)-$ , and
- $CF_2O-(CF_2CF_2O)_m-CF_2-$ ,

wherein x is an integer between 1 and about 10;

m and n designate the number of randomly distributed perfluoroethyleneoxy and perfluoromethyleneoxy backbone repeating subunits, respectively; and p designates the number of - $CF(CF_3)CF_2O-$  backbone repeating subunits.

35. The polymeric material of claim 32 having a  $C_H$  of less than about 55 M

36. The polymeric material of claim 32 having a  $C_H$  of less than about 20 M.

37. The polymeric material of claim 32 having a  $C_H$  of less than about 10 M.

38. The polymeric material of claim 32 having an absorption loss of less than about 0.5 dB/cm at 1550 nm.

39. An optical element comprising a polymeric core, the polymeric core including a polymer or copolymer of an energy curable compound having  
an aromatic or heteroaromatic moiety;  
at least two fluorinated alkylene, arylene or polyether moieties, each  
fluorinated alkylene, arylene or polyether moiety being linked to the aromatic or  
heteroaromatic moiety through an ether or thioether;

at least one ethylenically unsaturated moiety, each ethylenically unsaturated moiety being linked to one of the fluorinated alkylene, arylene or polyether moieties.

40. The optical element of claim 39 wherein the fluorinated alkylene, arylene or polyether moiety is selected from the group consisting of

$-(CF_2)_x-$ ,  
 $-(C_6F_4)_x-$   
 $-CF_2O-[ (CF_2CF_2O)_m(CF_2O)_n ]-CF_2-$ ,  
 $-CF(CF_3)O(CF_2)_4O[ CF(CF_3)CF_2O ]_pCF(CF_3)-$ , and  
 $-CF_2O-(CF_2CF_2O)_m-CF_2-$ ,

wherein x is an integer between 1 and about 10;

m and n designate the number of randomly distributed perfluoroethyleneoxy and perfluoromethyleneoxy backbone repeating subunits, respectively; and

p designates the number of  $-CF(CF_3)CF_2O-$  backbone repeating subunits.

41. The optical element of claim 39 wherein the polymeric core has a  $C_H$  of less than about 55 M.

42. The optical element of claim 39 wherein the polymeric core has an absorption loss of less than about 0.5 dB/cm at 1550 nm.

43. An optical element comprising a polymeric core, the polymeric core including a polymer or copolymer of an energy curable compound having

an isocyanurate moiety,  
three fluorinated alkylene, arylene, or polyether moieties linked to the isocyanurate moiety at the nitrogens of the isocyanurate, and  
at least one ethylenically unsaturated moiety linked to one of the fluorinated alkylene, arylene, or polyether moieties.

44. The optical element of claim 43 wherein the fluorinated alkylene, arylene or polyether moiety is selected from the group consisting of

-(CF<sub>2</sub>)<sub>x</sub>-,  
-(C<sub>6</sub>F<sub>4</sub>)<sub>x</sub>-  
-CF<sub>2</sub>O-[(CF<sub>2</sub>CF<sub>2</sub>O)<sub>m</sub>(CF<sub>2</sub>O)<sub>n</sub>]-CF<sub>2</sub>-,  
-CF(CF<sub>3</sub>)O(CF<sub>2</sub>)<sub>4</sub>O[CF(CF<sub>3</sub>)CF<sub>2</sub>O]<sub>p</sub>CF(CF<sub>3</sub>)-, and  
-CF<sub>2</sub>O-(CF<sub>2</sub>CF<sub>2</sub>O)<sub>m</sub>-CF<sub>2</sub>-,

wherein x is an integer between 1 and about 10;

m and n designate the number of randomly distributed perfluoroethyleneoxy and perfluoromethyleneoxy backbone repeating subunits, respectively; and p designates the number of -CF(CF<sub>3</sub>)CF<sub>2</sub>O- backbone repeating subunits.

45. The optical element of claim 43 wherein the polymeric core has a C<sub>H</sub> of less than about 55 M.

46. The optical element of claim 43 wherein the polymeric core has an absorption loss of less than about 0.5 dB/cm at 1550 nm.